



A.D. 1870, 21st DECEMBER. N° 3343.

SPECIFICATION

OF

ROBERT MANN LOWNE.

SPIROMETERS.

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A.D. 1870, 21st *DECEMBER*. N° 3343.

Spirometers.

LETTERS PATENT to Robert Mann Lowne, of East End, Finchley, in the County of Middlesex, for the Invention of "**IMPROVEMENTS IN SPIROMETERS.**"

Sealed the 20th June 1871, and dated the 21st December 1870.

PROVISIONAL SPECIFICATION left by the said Robert Mann Lowne at the Office of the Commissioners of Patents, with his Petition, on the 21st December 1870.

I, ROBERT MANN LOWNE, of East End, Finchley, in the County of Middlesex, do hereby declare the nature of the said Invention for
5 "**IMPROVEMENTS IN SPIROMETERS,**" to be as follows:—

Spirometers or instruments for measuring the vital capacity of the lungs have hitherto been made to act on the principle of a gasometer, being generally constructed of a cylindrical vessel or receiver immersed
10 in and wholly or partially filled with water, this vessel being balanced by weights attached to cords passing over pulleys, the air from the lungs is blown through a tube into the vessel thereby pressing upon the

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surface of the water which causes the vessel to rise in the water a distance according to the amount of air which has been sent into it from the lungs. The distance the vessel rises in the water can be measured on a dial by a hand or hands in connection therewith. The diameter of the receiver being known the hands may be made to denote 5 cubic inches. This form of spirometer must always be of such a size as to receive and retain the whole of the air the lungs are capable of emitting at one respiration, at the same time it requires a considerable amount of water and space which renders the instrument generally impracticable for portability. 10

Dry spirometers have been made similar in construction to a pair of bellows, being a box the sides of which open similar to a concertina or organ bellows; to ascertain the capacity of the lungs the box is pressed shut, there being a tube communicating with the interior by which the air contained in the box may escape. This tube also serves 15 to refill the box from the lungs. The distance the box opens is then measured, which when filled by the lungs can be made to shew their capacity. This form of spirometer is not satisfactory for if blown into quickly it is likely to shew too much and it takes several trials to get a true result. 20

Now my Invention consists in constructing spirometers as follows :— I employ a wheel with a number of fans or flat pieces of light metal attached to it. This wheel is pivoted so as to revolve freely, the fans are placed on the wheel with their surfaces at right or other angles to the plane of motion of the wheel; this fan wheel is enclosed in a 25 box about 3 inches in diameter and its arbor is either a pinion or an endless screw which gears into toothed wheels connected with hands which revolve on a dial so as to indicate cubic inches of air from the lungs. The air from the lungs is as in other spirometers blown through a tube made of india-rubber or other material, this tube is fitted to a 30 small condenser which is separate from the spirometer, the object of the condenser being to condense the moisture of the air from the lungs, the air passes out of the condenser through an india-rubber tube which is attached to the spirometer and communicates with the interior of a hollow vessel or receiver (which is immediately under and supports the 35 fan wheel box). The object of this receiver is to receive any water which might pass from the condenser; the air passes out of this receiver

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through a tube which enters the fan wheel box, the axis of this tube is in a line with the tangent of a circle described through the centres of the fans, so that the air which passes through it may strike directly upon the flat surfaces of the fans. The air when passing through this
5 tube causes the fans and wheel to revolve, the rate at which they revolve depending upon the velocity, consequently the force with which the air strikes them. Now if it is apparent that a given quantity of air striking the fans at a given velocity will always cause them to revolve at the same rate and the same number of revolutions, other contingencies
10 being the same, it will likewise be seen that when the moving air has ceased to drive the fans they will still revolve from the momentum they have acquired, this momentum would cause the fans to revolve considerably more after they had acquired a high velocity than it would at a low velocity; this revolving of the fans from their momentum
15 after the air had ceased to act on them I found a cause of inaccuracy, for before the fans would stop their motion became very slow, and small causes arising from friction and imperfect workmanship caused them sometimes to stop suddenly and before they otherwise would. To obviate this defect I employ a small piston of glass or other suitable
20 material which is acted upon by the internal pressure of the air from the receiving box; this piston is fitted loosely in a tube, one end of which communicates with the interior of the receiver, and the other enters the fan box; this tube is perpendicular so as to allow the piston to fall by its own weight, the piston is so arranged that its weight is
25 borne by one end of a lever, the other end of which has a stop or pin on it which catches and fixes the wheelwork connected with the hands. On blowing into the instrument the piston rises and allows the end of the lever which has the stop to fall, thereby releasing the wheelwork. Directly the velocity and consequently the pressure of the air have
30 ceased the piston falls to its original position thereby pressing on the lever and raising the end, which again catches the wheelwork. The piston is fitted loosely in the tube; I avoid making it air-tight in order that it may act with the slightest pressure from beneath; thus it will be seen that there will be a considerable escape of air between
35 the piston and cylinder, this escape I conduct through a small pipe placed so that the air which passes through it strikes upon the fans in a direction to make them revolve. All the air might be sent between the piston and cylinder, or the air might be allowed to pass

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through the pipe which contains the piston, the air raising the piston so as to open an aperture and allow its escape, but I prefer the arrangement first described. The stop although it instantaneously stops the hands does not stop the fan wheel but allows it to revolve to expend its momentum, the fan wheel is thus prevented from being injured by the 5
jerk which would ensue from suddenly checking its motion. The dial of the instrument has its circumference divided by preference into 50 divisions, each of which when traversed by the long centre hand represents a cubic inch; within this divided circle is a small circle divided into eight divisions, each of which when traversed by the small 10
hand denotes 50 cubic inches or one revolution of the long hand. Thus one revolution of the small hand will shew 400 cubic inches which are practically more than is required for testing the capacity of the lungs.

For the convenience of reading the hands I employ a method by which the hands can be set at zero without moving the fan wheel; this 15
is done by so fixing the arbor of the long hand on its wheel that it can revolve without such wheel carrying with it the wheel of the small hand which gears into or is connected with the arbor of the long hand. The hands are set by a screw which is kept out of gear by a spring; this spring on being pressed puts the screw in gear with the 20
arbor of the long hand. At the end of the screw projecting from the instrument is a milled button by which to set the hands.

SPECIFICATION in pursuance of the conditions of the Letters Patent,
filed by the said Robert Mann Lowne in the Great Seal Patent
Office on the 21st June 1871. 25

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, ROBERT MANN LOWNE, of East End, Finchley, in the County of Middlesex, send greeting.

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Twenty-first day of December, in the 30
year of our Lord One thousand eight hundred and seventy, in the thirty-fourth year of Her reign, did, for Herself, Her heirs and successors, give and grant unto me, the said Robert Mann Lowne, Her special licence that I, the said Robert Mann Lowne, my executors, administrators, and

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assigns, or such others as I, the said Robert Mann Lowne, my executors, administrators, and assigns, should at any time agree with, and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and
5 vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for “IMPROVEMENTS IN SPIROMETERS,” upon the condition (amongst others) that I, the said Robert Mann Lowne, my executors or administrators, by an instrument in writing under my, or their, or one of their hands and seals,
10 should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

15 **NOW KNOW YE**, that I, the said Robert Mann Lowne, do hereby declare the nature of my said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof, reference being had to the accompanying Drawings, that is to say :—

20 Spirometers or instruments for measuring the vital capacity of the lungs have hitherto been made to act on the principle of a gasometer, having been generally constructed of a cylindrical vessel or receiver immersed in and wholly or partially filled with water, this vessel being balanced by weights attached to cords passing over pulleys ; the air from
25 the lungs is blown through a tube into the vessel, thereby pressing upon the surface of the water, which causes the vessel to rise in the water a distance according to the amount of air which has been sent into it from the lungs. The distance the vessel rises in the water can be measured on a dial by a hand or hands in connection therewith. The
30 diameter of the receiver being known, the hands may be made to denote cubic inches. This form of spirometer must always be of such a size as to receive and retain the whole of the air the lungs are capable of emitting at one respiration ; at the same time it requires a considerable amount of water and space which renders the instrument generally
35 impracticable for portability.

Dry spirometers have been made similar in construction to a pair of bellows, being a box the sides of which open like a concertina or organ

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bellows ; to ascertain the capacity of the lungs the box is pressed shut, there being a tube communicating with the interior by which the air contained in the box may escape. This tube also serves to refill the box from the lungs. The distance the box opens is then measured which when filled by the lungs can be made to shew their capacity. This form of spirometer is not satisfactory, for if blown into quickly it is likely to shew too much, and it takes several trials to get a true result. 5

Now my Invention consists in constructing spirometers as herein-after described, and as represented in the annexed Drawings.

Figure 1 is a vertical section through the line 1- - -1 of Figure 2 of a spirometer constructed according to my Invention. Figures 2 and 3 are horizontal sections of the same through the lines 2- - -2 and 3- - -3 respectively of Figure 1 ; these Figures are drawn on an enlarged scale. Figure 4 is an elevation, and Figure 5, a plan of my spirometer of the size I prefer to make it. Figures 6, 7, and 8, are respectively a side elevation, a horizontal section, and a vertical section of a condenser to be used with my spirometer, as herein-after explained. 10 15

In my spirometers, I employ a wheel *a* with a number of fans or flat pieces *b* of light metal attached to it. This wheel is pivoted so as to revolve freely ; the fans are placed on the wheel with their surfaces at right or other angles to the plane of motion of the wheel. This fan wheel is enclosed in a box *c* about three inches in diameter, and its arbor *d* is either a pinion (as shewn) or an endless screw which gears with a train of toothed wheels connected with hands which revolve on a dial, so as to indicate cubic inches of air from the lungs. As will be seen on reference to the Figures the pinion *d* gears with a wheel *e*, on the arbour of which is a pinion *h* ; the pinion *h* gears with a wheel *i* the arbor of which carries the hand *j* for indicating cubic inches. From the arbor of the hand the pinion *k* and wheels *l* and *m* transmit the motion to the other hand *n*. The air from the lungs is, as in other spirometers, blown through a tube *o*, Figure 6, made of india-rubber or other material ; this tube is fitted to a small condenser as shewn, which is separate from the spirometer, the object of the condenser which may be of any suitable construction being to condense the moisture of the air from the lungs. The air passes out of the condenser through an india-rubber tube *p* which is attached to the spirometer at *q*, and communicates 20 25 30 35

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with the interior of a hollow vessel or receiver *r* (which is immediately under and supports the fan wheel box *c*). The object of this receiver *r* is to receive any water which might pass from the condenser. The air passes out of this receiver through a tube *s* which enters the fan wheel box *c*. The axis of this tube *s* is in a line with the tangent of a circle described through the centres of the fans *b*, so that the air which passes through it may strike directly upon the flat surfaces of the fans. The air when passing through this tube causes the fans and wheel to revolve, the rate at which they revolve depending upon the velocity, consequently the force with which the air strikes them. Now it is apparent that a given quantity of air striking the fans at a given velocity will always cause them to revolve at the same rate and the same number of revolutions, other contingencies being the same; it will likewise be seen that when the moving air has ceased to drive the fans they will still revolve from the momentum they have acquired; this momentum would cause the fans to revolve considerably more after they had acquired a high velocity than it would at a low velocity. This revolving of the fans from their momentum after the air had ceased to act on them I found a cause of inaccuracy, for before the fans would stop their motion became very slow, and small causes arising from friction and imperfect workmanship made them sometimes stop suddenly before they otherwise would. To obviate this defect, I employ a small piston *t* of glass or other suitable material which is acted upon by the internal pressure of the air from the receiving box *r*; this piston is fitted loosely in a tube *u*, one end of which communicates with the interior of the receiver at *u*¹, and the other enters the fan box as shewn. The tube *u* is perpendicular so as to allow the piston to fall by its own weight; the piston is so arranged that its weight is borne by one end of a lever *v* centred at about its middle, and the other end of which has a stop or pin *w* on it which catches the arm *x* on the arbor of the pinion *d*, and thereby fixes the wheelwork connected with the hands. On blowing into the instrument the piston *t* rises and allows the end of the lever *v* which has the stop to fall, thereby releasing the wheelwork. Directly the velocity and consequently the pressure of the air have ceased the piston falls to its original position, thereby pressing on the lever and raising the end which has the stop, which again fixes the wheelwork. The piston *t* is fitted loosely in the tube as is before stated; I avoid making it air-tight in order that it may act with the slightest pressure from beneath; thus it will be seen that there

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will be a considerable escape of air between the piston and cylinder, this escape may, if thought necessary, be conducted through a small pipe placed so that the air which passes through it strikes upon the fans in a direction to make them revolve. All the air might be sent between the piston and cylinder, or the air might be allowed to pass through the 5 pipe which contains the piston, the air raising the piston so as to open an aperture and allow its escape, but I prefer the arrangement first described. The stop *w*, although it instantaneously stops the hands, does not stop the fan wheel, but allows it to revolve to expend its momentum, and for this purpose the fan wheel is not fixed on its 10 arbor, but is held on it by a spring *y* which yields when the wheel-work is stopped. The fan wheel is thus prevented from being injured by the jerk which would ensue from suddenly checking its motion. The dial of the instrument has its circumference divided by preference into 50 divisions, each of which when traversed by the long centre hand *j* 15 represents a cubic inch; within this divided circle is a small circle divided into eight divisions, each of which when traversed by the small hand *n* denotes 50 cubic inches or one revolution of the long hand. Thus one revolution of the small hand will shew 400 cubic inches, which are practically more than is required for testing the capacity of the lungs. 20

For the convenience of reading the hands I employ a method by which the hands can be set at zero without moving the fan wheel; this is done by so fixing the arbor of the long hand on its wheel that it can revolve without such wheel carrying with it the wheel of the small hand which gears into or is connected with the arbor of the long hand. The 25 hands are set by a screw *z* which is kept out of gear by a spring *A*; this spring on being pressed by the finger acting against the projecting part *B* puts the screw in gear with the arbor of the long hand. At the end of the screw projecting from the instrument is a milled button *C* by which to set the hands. 30

Although in the foregoing description and in the Drawings I have explained and shewn the manner in which I prefer to construct my spirometers, yet I wish it to be clearly understood that the details may be varied in many ways without departing from the essential features of my Invention, viz., the fan wheel acted upon by the air from the lungs 35 as described, the receiver for receiving any water which may pass from the condenser, the means of instantaneously stopping the motion of the

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wheelwork or hands when the pressure of the air ceases and without too suddenly stopping the fan wheel, the means of setting the hands at zero without moving the fan wheel, the general arrangement of the spirometer, and the combination or combined use of a condenser there-
5 with.

I claim constructing spirometers substantially as herein-before described and represented in the accompanying Drawings.

In witness whereof, I, the said Robert Mann Lowne have hereunto
set my hand and seal, this Twentieth day of June One thousand
10 eight hundred and seventy-one.

R. M. LOWNE. (L. S.)

LONDON :

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FIG. 4.

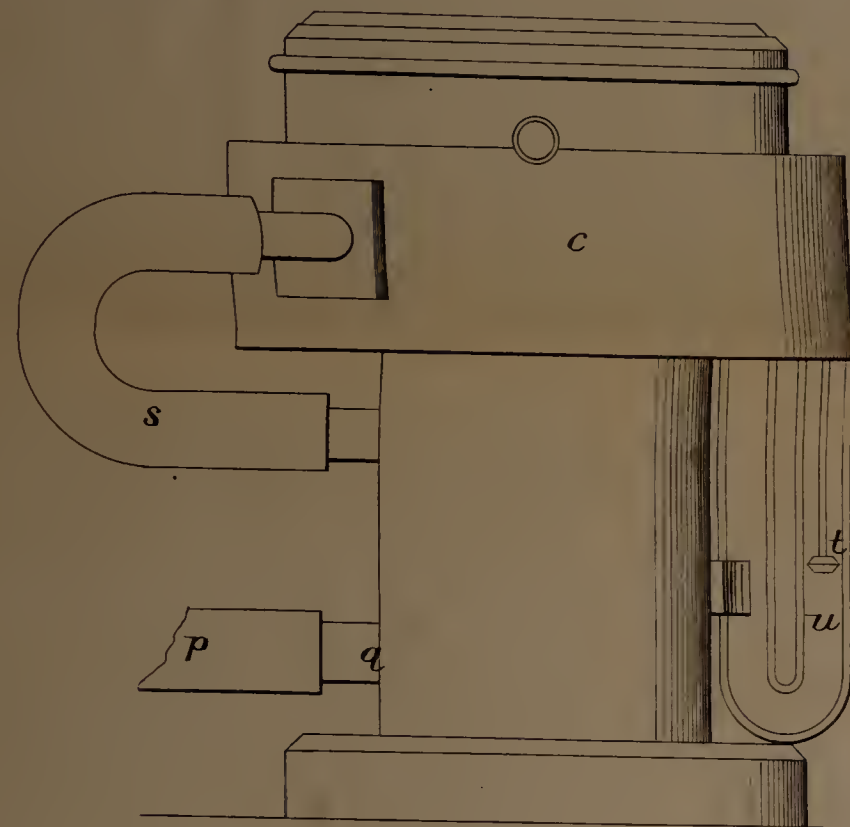


FIG. 6.

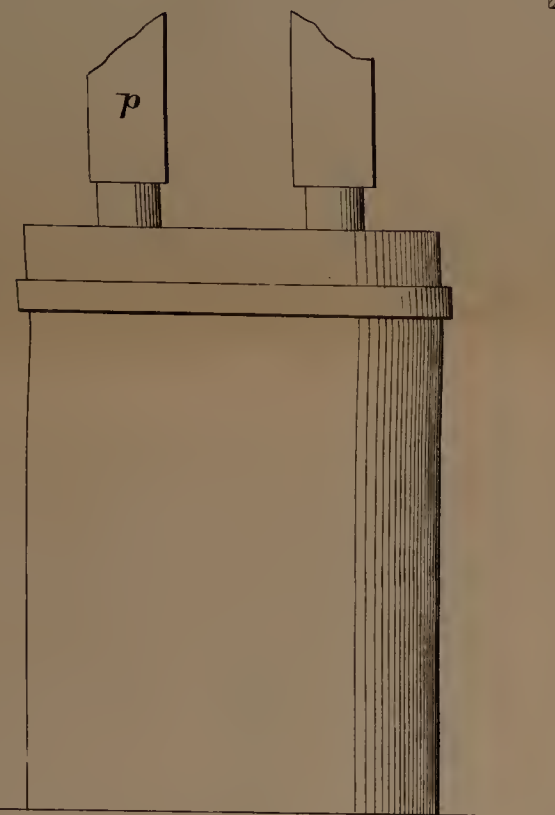


FIG. 5.



FIG. 7.

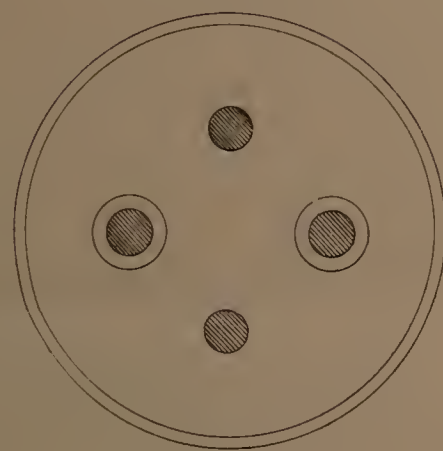


FIG. 1.

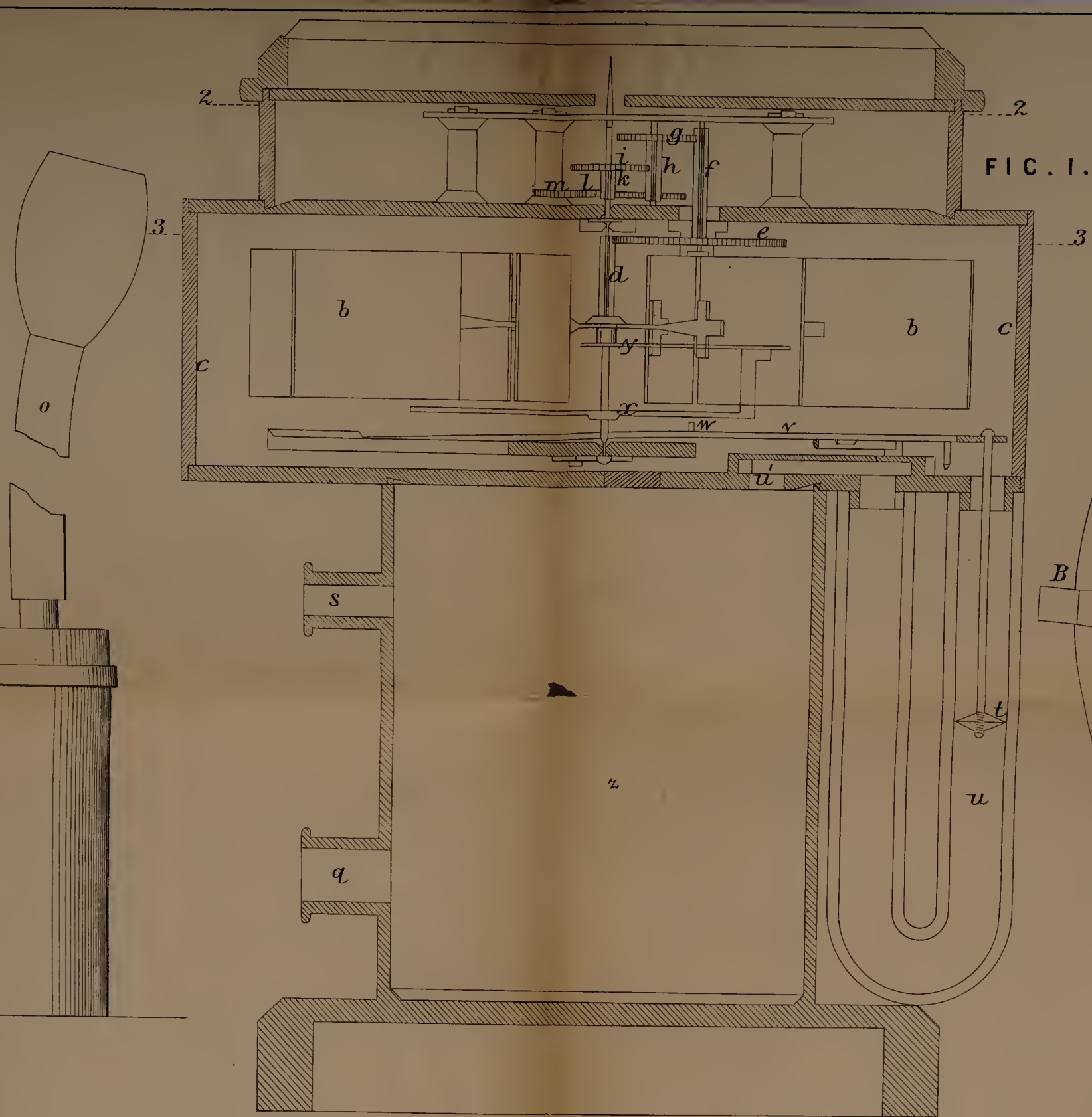


FIG. 3.

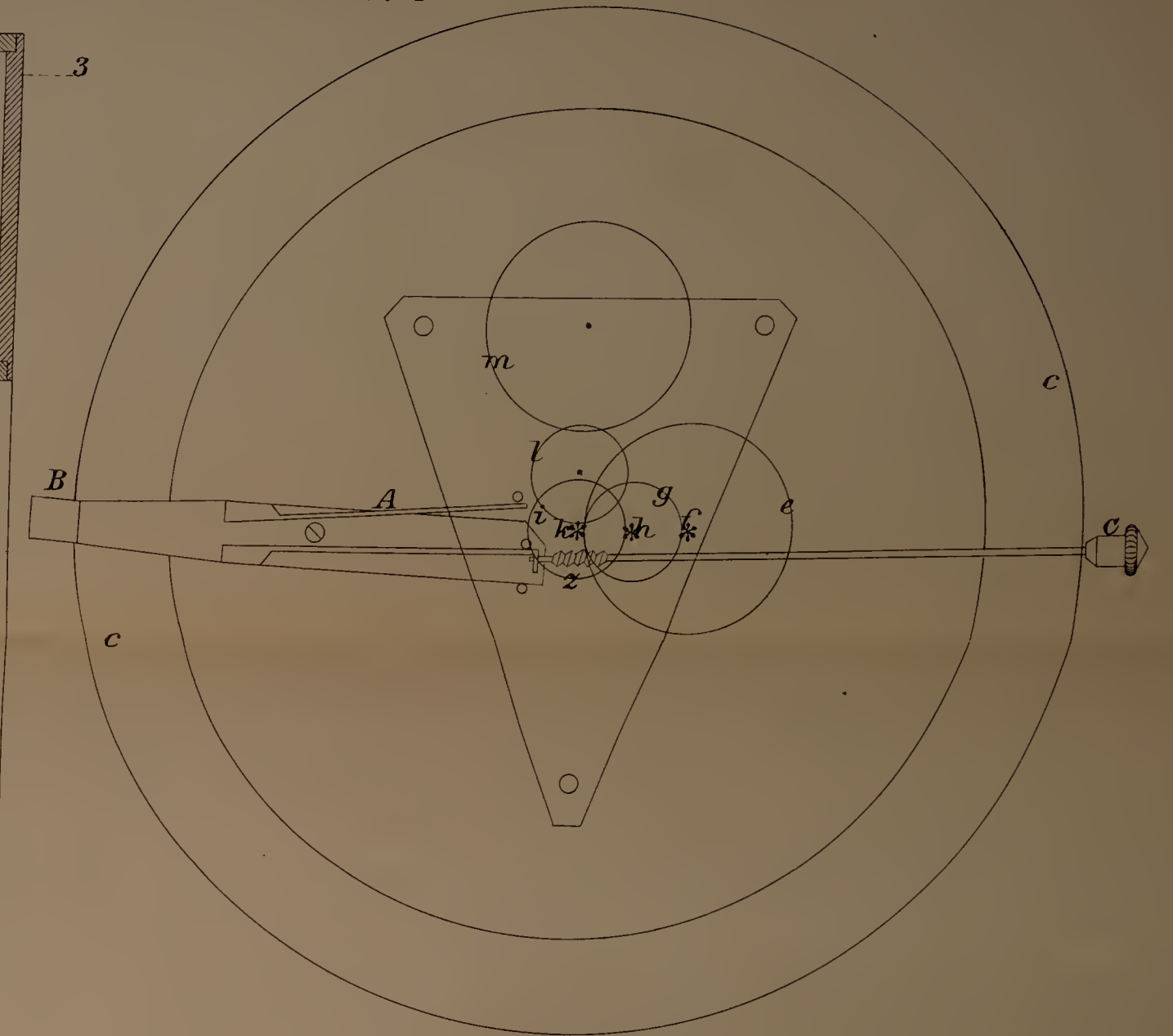


FIG. 2.

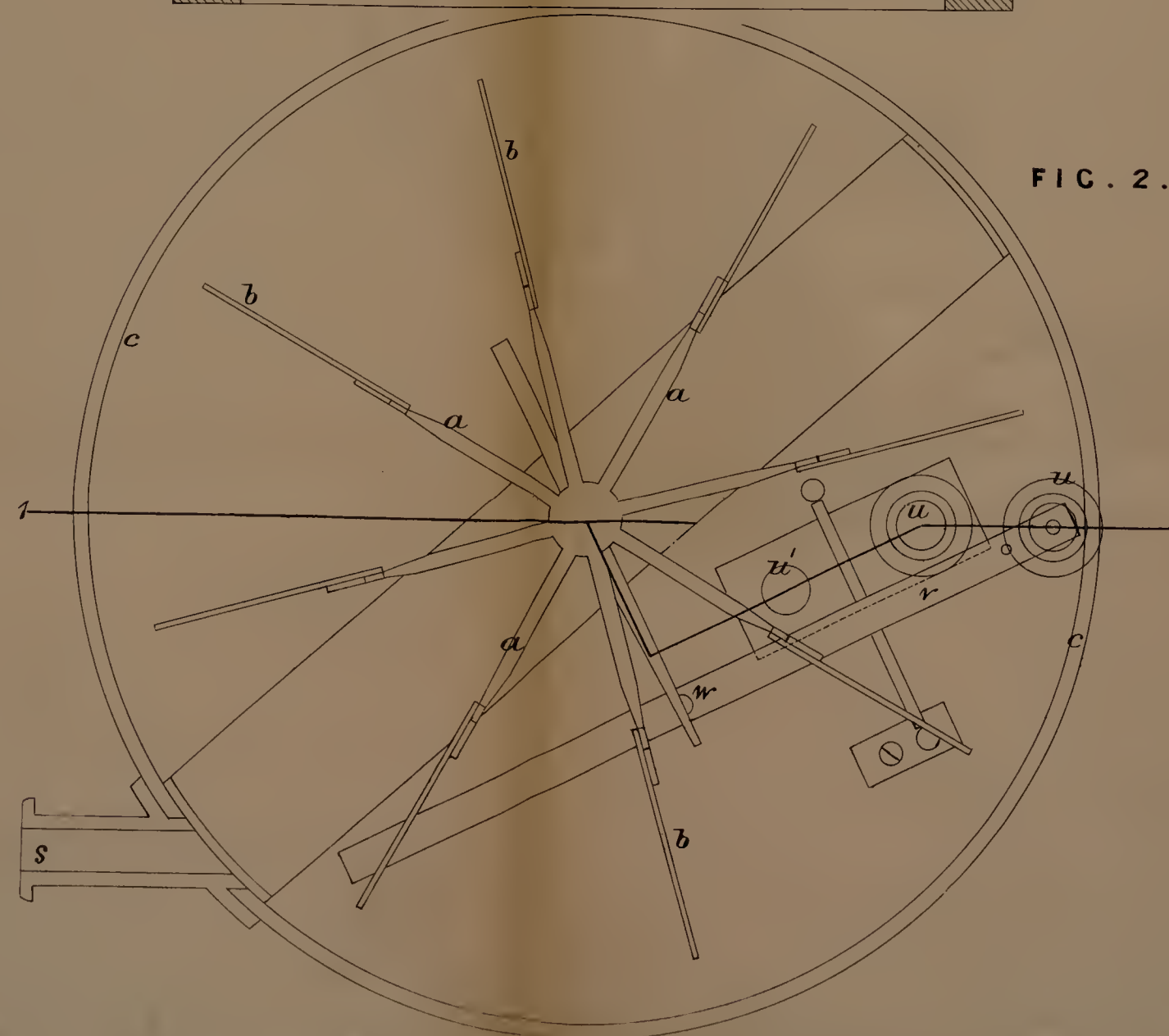


FIG. 8.

